WHAT IS CLAIMED IS:

1. A projection exposure apparatus, comprising:

a projection optical system for projecting a transfer pattern of a first object onto a second object;

a first illumination system for performing illumination under a first illumination condition, wherein the transfer pattern of the first object illuminated under the first illumination condition is projected onto the second object through said projection optical system;

a second illumination system for performing illumination under a second illumination condition;

a light intensity detector; and

an information processing system operable, as a particular pattern being illuminated by said second illumination system under the second illumination condition is imaged by said projection optical system, to measure a wavefront aberration of said projection optical system on the basis of detection of a light intensity distribution of an image of the particular pattern made through said light intensity detector.

2. An apparatus according to Claim 1, wherein said information processing system is arranged to detect a phase distribution of the image of the particular pattern on the basis of light intensity

distributions defined in relation to that image at different positions along an optical axis direction of said projection optical system, and to measure the wavefront aberration of said projection optical system on the basis of the detected phase distribution.

3. An apparatus according to Claim 1, wherein the second object is a photosensitive substrate, and wherein said projection optical system is used to project and print the transfer pattern, being illuminated under the first illumination condition, onto an exposure region on the photosensitive substrate.

4. An apparatus according to Claim 1, wherein said information processing system is arranged to measure the wavefront aberration of said projection optical system on the basis of light intensity distributions detected with respect to an imaging position of the image of the particular pattern and at least one defocus position of thereof, or of light intensity distributions with respect to different positions.

5. An apparatus according to Claim 4, wherein said information processing system measures the wavefront aberration of said projection optical system

in accordance with a phase restoration method.

6. An apparatus according to Claim 4, wherein said first and second illumination systems include a common element.

7. An apparatus according to Claim 1, wherein said first and second illumination systems are different in respect to a spatial coherency.

8. An apparatus according to Claim 7, wherein the first illumination condition concerns being spatially partially coherent or being incoherent, and wherein said second illumination condition concerns being spatially coherent or being approximately coherent.

9. An apparatus according to Claim 7, wherein, in each of said first and second illumination systems, a ratio of a numerical aperture of said first or second illumination system to a numerical aperture of said projection optical system is σ, and wherein the first illumination condition satisfies a relation $0.2<\sigma\leq 1.0$ while the second illumination condition satisfies a relation $\sigma\leq 0.2$.

10. An apparatus according to Claim 7, wherein

said first and second illumination systems include a common element.

11. An apparatus according to Claim 10, further comprising a separate optical system which can be demountably added to said common element, to thereby interchange the first and second illumination conditions each other.

12. An apparatus according to Claim 10, wherein interchanging the first and second illumination conditions each other is performed by changing a light source to said common element.

13. An apparatus according to Claim 1, wherein said first and second illumination systems use different optical systems.

14. An apparatus according to Claim 13, wherein the optical system of said second illumination system has an additional use, other than for detection of wavefront aberration information.

15. An apparatus according to Claim 14, wherein said second illumination optical system is arranged to change its illumination condition between for the detection of wavefront aberration information and for

the additional use.

16. An apparatus according to Claim 15, wherein, for the detection of the wavefront aberration information, said second illumination system sets an illumination condition satisfying a relation $\sigma \leq 0.2$ where σ is a ratio of a numerical aperture of said second illumination system to a numerical aperture of said projection optical system.

17. An apparatus according to Claim 15, wherein, for the detection of the wavefront aberration information, said second illumination system sets an illumination condition satisfying a relation $\sigma = 0$ where σ is a ratio of a numerical aperture of said second illumination system to a numerical aperture of said projection optical system.

18. An apparatus according to Claim 13, wherein said first and second illumination systems use different light sources.

19. An apparatus according to Claim 1, wherein said light intensity detector measures a light intensity distribution in accordance with a knife edge method.

20. An apparatus according to Claim 1, further comprising an enlarging optical system for enlarging a light intensity distribution to be incident on said light intensity detector.

21. An apparatus according to Claim 1, further comprising an adjusting mechanism for adjusting an aberration of said projection optical system on the basis of wavefront aberration information detected by said information processing system.

22. An apparatus according to Claim 1, further comprising means for adjusting an aberration of said projection optical system, prior to projection of the transfer pattern onto the second object through said projection optical system, on the basis of wavefront aberration information detected by said information processing system and information related to the transfer pattern.

23. An apparatus according to Claim 1, wherein said second illumination system is usable for alignment between the first and second objects.

24. A device manufacturing method, comprising:

a projection exposure step for projecting a pattern of a reticle onto a wafer by use of a

projection exposure apparatus including (i) a projection optical system for projecting a transfer pattern of the reticle onto the wafer, (ii) a first illumination system for performing illumination under a first illumination condition, wherein the transfer pattern of the reticle illuminated under the first illumination condition is projected onto the wafer through the projection optical system, (iii) a second illumination system for performing illumination under a second illumination condition, (iv) a light intensity detector, and (v) an information processing system operable, as a particular pattern being illuminated by the second illumination system under the second illumination condition is imaged by the projection optical system, to measure a wavefront aberration of the projection optical system on the basis of detection of a light intensity distribution of an image of the particular pattern made through the light intensity detector; and

a developing step for developing the wafer processed by said projection exposure step, whereby a device can be produced from the developed wafer.

25. A method according to Claim 24, further comprising an adjusting step for adjusting an aberration of the projection optical system on the basis of the detected wavefront aberration.